Results: A completion angiogram showed complete exclusion of the ruptured pseudoaneurysm and no evidence of endoleak (Fig 2, *B*). The patient was hemodynamically stable and asymptomatic after repair, with complete resolution of abdominal pain.

Conclusions: FEVAR is a useful treatment modality for urgent aortic pathology not amenable to EVAR or open repair.

Endovascular Repair of Blunt Popliteal Artery Injury via Retrograde Tibial Access

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Introduction: Popliteal artery injuries from posterior knee dislocations are associated with limb-threatening ischemia and amputation. Endovascular approaches to trauma surgery are gaining increased acceptance, especially for solid-organ injury and aortic transections. We present a case of posterior knee dislocation with popliteal artery transection resulting in a pulseless extremity, in which revascularization was accomplished via a retrograde approach from percutaneous, ipsilateral posterior tibial artery access.

Methods: A 34-year-old man presented after fall from the bed of his truck. He complained of sharp pain to the posterior right knee and coldness of the calf and foot. Physical examination revealed an obese man (body mass index, 53 kg/m^2) in mild distress. His Glasgow Coma Scale was normal and he was hemodynamically stable. His right popliteal region was ecchymotic, swollen, and tender with decreased range of motion of the knee. The calf and foot were cold with preserved motor and sensory function. Popliteal, dorsalis pedis, and posterior tibial artery pulses were not palpable, and Doppler signals could not be obtained. The patient was taken to the hybrid endovascular operating room within 1 hour of initial presentation for revascularization and placement of external fixator device. Via contralateral common femoral artery access, selective arteriography was performed of the right superficial femoral artery. Thrombosis of the above knee popliteal artery, with reconstitution of the below-knee popliteal artery, was seen (Fig 1). Attempts to cross the lesion from this antegrade approach resulted in perforation. Under ultrasound guidance, a 2.6F sheath was placed in the posterior tibial artery at the level of the ankle. A wire was successfully passed from this access, through the occlusion and out the contralateral femoral artery access. A 6 millimeter diameter by 15 centimeter length covered stent graft was deployed across the lesion (Fig 2). Completion arteriogram demonstrated restoration of prograde flow without extravasation or embolization.

Results: Distal pulses were palpable at the completion of the case. Motor and sensory function remained intact postoperatively, and patient did not require fasciotomy. Plasma creatinine remained within normal limits. Estimated blood loss from these procedures was 80 mL. He was transferred out of the intensive care unit on postoperative day 1 and discharged on day 4 on clopidogrel. At the 3-month follow-up, he remained in good condition with palpable distal pulses.

Conclusions: Endovascular intervention has the potential to lower blood loss, reduce surgical morbidity, and shorten procedure and recovery times from vascular trauma. Use of covered stents and filter wires with anterograde and retrograde access techniques can provide novel ways to manage popliteal artery injuries. Further investigation with long-term follow-up will be useful in determining the effectiveness and durability of these repairs.

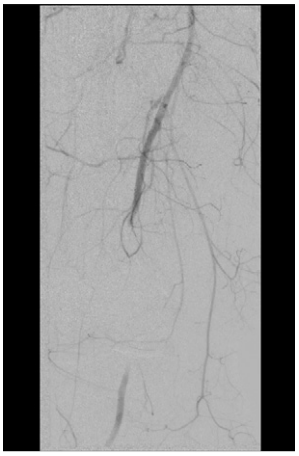

Fig 1.

Fig 2.

Complex Endovascular Perirenal Aortic Aneurysm Repair Preserving Perfusion to a Horseshoe Kidney

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Introduction: Improvements in endovascular technology have allowed a larger range of abdominal aortic aneurysms (AAA) to be treated with endovascular approaches, but horseshoe kidneys continue to present challenging anatomy for even open surgical repairs. Additionally, it has been clearly demonstrated that renal failure after abdominal aneurysm repair increased postoperative mortality. This report describes a case of an elderly man with significant comorbidities and a perirenal horseshoe kidney whose AAA was successfully treated with a complex endovascular repair to preserve renal function.

Methods: An 83-year-old man with a history of severe emphysema and hypertension presented with a symptomatic 7.1-cm AAA and acute renal insufficiency. A computed tomography additionally demonstrated a 6.4-cm right iliac artery aneurysm, a 2.6-cm left common femoral artery aneurysm, and a horseshoe kidney, with his left renal artery origin proximal to the

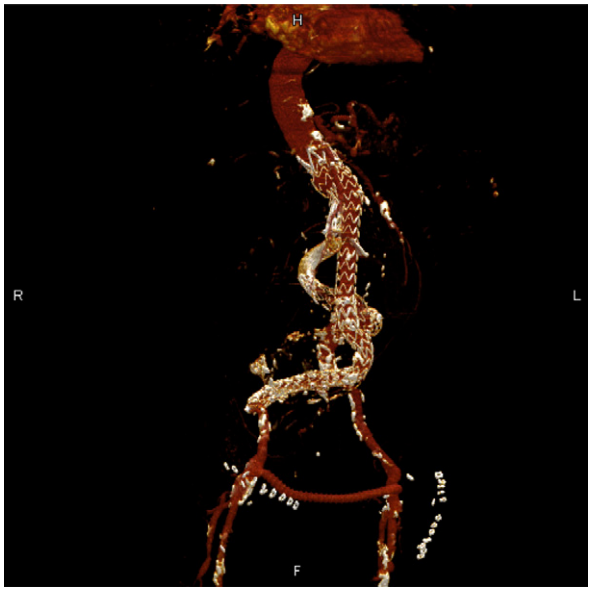

Fig.

aneurysm neck but a right renal artery supplied from the body of the aneurysm. Given the severity of his pulmonary disease, risk of embolization of his renal arteries, as well as difficulty of cross-clamping the aorta with the horseshoe kidney, the decision was made to perform an EVAR with preservation of his right renal artery. The left common femoral artery aneurysm was excised and replaced with a 10-mm Dacron graft and an Endurant (Medtronic, Minneapolis, Minn) main body deployed via the left common femoral artery. His iliac arteries were severely tortuous, making cannulation of the contralateral gate extremely difficult, so the gate was cannulated via left brachial access. An occlusion plug was used to occlude the gate and convert the endograft into an aortouniiliac system. The right renal artery was then serially stented with two iCAST (Atrium Medical Corp, Hudson, NH) stents, a Viabahn (W L Gore & Associates, Flagstaff, Ariz) stent, and two Endurant limb extensions into the distal common iliac artery. A femoral-femoral bypass was then performed to provide left leg perfusion (Fig).

Results: Completion angiography demonstrated straight-line flow from the aorta to the right iliac limb, across the femoral-femoral bypass with perfusion of the right renal artery via retrograde filling of the left common iliac artery with no evidence of a leak. Follow-up computed tomography at 2 weeks demonstrated filling of the right renal artery and entirety of the horseshoe kidney, with no evidence of endoleak. His creatinine remained at 0.9 postoperatively.

Conclusions: Patients presenting with both AAA and horseshoe kidneys are rare, reported in the literature as only 0.12% of AAAs. This patient presented with the challenging anatomy of not only a horseshoe kidney but also a perirenal AAA. Options included reimplantation or ligation of the right renal artery, but would have necessitated an open surgery or worsened renal failure in this patient. The complex aneurysm repair chosen demonstrates an alternative method, allowing for preservation of the perfusion and function of his horseshoe kidney.

Pulmonary Embolism Risk Following Upper Extremity DVT in a Single-Center Series of 500 Consecutive Patients

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Introduction: The reported incidence of pulmonary embolism (PE) associated with isolated upper extremity deep venous thrombosis (UEDVT) is variable (1%-13%). As per *Chest* 2008 guidelines, many clinicians treat UEDVT with anticoagulation to ameliorate symptoms, and decrease the risk of subsequent PE. After the analysis of a smaller cohort of UEDVT patients, we had previously reported a low risk of PE attributable to UEDVT. We here expand our analysis to 500 UEDVT patients and compare the observed outcomes for PE and hemorrhagic risk among anticoagulated (AC) and non-AC (NAC) patients.

Methods: Between April 2005 and July 2010, 500 consecutive UEDVT patients were identified from a prospectively maintained registry. A retrospective analysis was then performed among AC and NAC patients, comparing patient demographics and outcomes as well as UEDVT characteristics. The decision to anticoagulate patients reflected the judgment of the treating physicians and was not randomized.

Results: UEDVTs were identified in the distal innominate (n = 113), internal jugular (n = 239), subclavian (n = 261), axillary (n = 190), and brachial veins (n = 164), with many patients having multiple named venous segments involved. Most UEDVTs had sonographically acute components (86%). Among the 500 patients, 297 were AC (59%), and 203 were NAC. There were 403 patients (81%) with catheter-associated UEDVT. Most patients were symptomatic, and the AC patients had more UEDVT segments involved (Table). There were no statistically significant differences in the treatment groups related to trauma or postoperative status, malignancy, renal failure, diabetes, coronary artery disease, or obesity. AC patients were younger than NAC patients, with less associated comorbidities. The NAC group demonstrated decreased survival, perhaps owing to older patient age and more comorbidities, but not due to increased PE rates. The overall rate of UEDVT-associated PE was 3%, with no associated mortality. Among the 15 patients suffering PE in association with their UEDVT, eight presented with simultaneous PE and UEDVT, and were AC. Only seven patients suffered PE subsequent to a primary diagnosis of UEDVT, of which most (5 of 7) were AC. After hospital discharge, four of the UEDVT patients treated with anticoagulation developed fatal intracranial bleeds. Seven additional patients had their anticoagulation discontinued early due to hemorrhagic complications requiring hospital readmission and transfusion.

Conclusions: We continue to observe that clinicians choose to anticoagulate UEDVT patients that are younger, with more extensive thrombus burdens. The risk of PE subsequent to UEDVT diagnosis remains small however, and we observed no evidence that anticoagulation dampens this risk. In light of the persistent risk of hemorrhagic complications demonstrated among this fragile patient group, our patient outcomes do not support routine anticoagulation among UEDVT patients.

Table.

Patient/UEDVT characteristics	*NAC (n = 203)*	*AC (n = 297)*	P
Patient age, years	54 ± 17	50 ± 18	.02[a]
Mortality at 3 months, No. (%)	57 (28)	44 (15)	<.0001[b]
Symptomatic, No. (%)	174 (86)	268 (90)	.12[b]
UEDVT-associated PE, No. (%)	2 (1.0)	13 (4)	.022[b]
Malignancy, No. (%)	77 (38)	96 (32)	.12[b]
Named DVT segments, No	1.7 ± 1.0	2.1 ± 1.1	<.0001[a]

[a] *t* test; [b] χ^2

Early Outcomes After Inferior Vena Cava Thrombectomy and Reconstruction For Advanced Renal Cell Carcinoma With Tumor Thrombus

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Introduction: Advanced-stage renal cell carcinoma (RCC) with and inferior vena cava (IVC) thrombus is associated with poor clinical outcomes. This report details the results of a multidisciplinary surgical team who addresses the surgical component of stage III and IV RCC.

Methods: A retrospective inquiry of our vascular database from 2003 to 2012 identified 55 surgical cases done for stage III (n = 40) and stage IV (n = 15) RCC. The character of tumor and inferior vena cava (IVC) tumor thrombus was evaluated by clinical staging preoperatively and pathology staging postoperatively. Patient demographics and surgical reconstruction is detailed. Reconstructions were evaluated by oncologic surveillance with computed tomography (CT) or magnetic resonance (MR) imaging. Patients received venous thromboembolism (VTE) prophylaxis. Antiplatelet therapy was continued if indicated medically. A Clavien-Dindo classification of early (<30-day) surgical complications and mortality was recorded, including a review of secondary surgical interventions.

Results: According to Novick classification for IVC thrombus, there were 10 diaphragmatic (level IV), 20 retrohepatic (level III), and 25 infrahepatic (level II or I) tumor thrombi. IVC reconstruction was completed in 54 patients (98%), with one patient deemed unresectable. IVC control required cardiac bypass (n = 10), venovenous bypass (n = 4), or infrahepatic IVC control (n = 40). Reconstruction of the IVC was completed with two prosthetic interposition grafts done for one stage IV and one stage III thrombus, two patch repairs done for stage III thrombus, and 50 primary IVC repairs. VTE prophylaxis involved sequential compression devices (n = 54), unfractionated or fractionated heparin (n = 17). Anticoagulation with heparin and warfarin was administered for two patients with postoperative pulmonary embolus and one patient with chronic bilateral ileofemoral venous thrombosis. No other hospital VTE events occurred, and all other IVC reconstructions were patent at a mean follow-up of 23 months. One asymptomatic patient with primary ICV repair had estimated 30% IVC narrowing but no other measurable stenosis as detected by postoperative imaging. Three patients required reoperation (2 for surgical site bleeding, 1 for small-bowel fistula). Early surgical complications included Clavien-Dindo classification grade I (n = 3), II (n = 6), IIIa (n = 2), IIIb (n = 3), and V (n = 2). Regional retroperitoneal or distant recurrent RCC occurred in 26 patients (48%), with one patient demonstrating recurrent IVC tumor thrombus at 8 months requiring secondary IVC thrombectomy. All patients with tumor invasion of the IVC wall developed recurrent RCC, and no patient survived 5 years. Early mortality was 3.6% (n = 2), with an additional 27 patients (49%) dying within 24 months and an overall group mortality of 80% (n = 44) during surveillance.

Conclusions: A multidisciplinary approach for perioperative management of advanced RCC helps optimize surgical outcomes. Primary IVC repairs are possible in most patients, and IVC patency is good without use of complex anticoagulation protocols. Early IVC recurrent thrombus rates are low; however, RCC tumor recurrence and mortality is high among patients with advanced cancers with IVC wall invasion.

Nutcracker Syndrome in a Pelvic Kidney Treated With Open Iliac Vein Reconstruction

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Introduction: To our knowledge, this is the only reported case of nutcracker syndrome occurring in a left pelvic kidney. This resulted from compression of the left renal vein outflow by the overlying right common iliac artery. We treated this condition with a novel operation in which we transposed the left iliac vein anterior to the iliac artery.

Methods: An 18-year-old woman presented with left lower quadrant abdominal pain, worsening hematuria, and anemia. She was found to have a left pelvic kidney, and subsequent cystoscopy demonstrated bloody urine from the left ureter. Subsequent magnetic resonance angiography and